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Question No. 1 Answer:

The advantage of circuit-switched network over package switched network is there is a dedicated path for entire communication in a circuit switched network. In the circuit-switched network, there are no unpredictable performance issues as everything is predictable and consistent including delays and jitters in the network. As there is a dedicated path, the traffic does not have to compete for the resources once the circuit is established which is not the case in package switched networks. Circuit-switched is a lot better to use for real time application as well because of the advantages it offers.

In circuit-switched networks, Time Division Multiplexing and Frequency Division Multiplexing are both multiplexing techniques in circuit-switched networks. The advantages of TDM over FDM is that there is no cross interference as the time slots are completely separate and unlike Frequency Division in which there could be a lot of interference. And at the same time in TDM, the whole bandwidth is available to the user in their dedicated time slot so it offers better utilization of resources.

Question No. 2 Answer:

The ISPs at the same level of hierarchy often peer with each other because it's easier to connect with the same level of ISPs because of technical reasons and it also helps to save the cost while connecting with the same hierarchy of the ISP as there is no fee involved but while connecting with the ISPs of higher levels there could be some transit fees that are involved in the process. The ISPs in the same hierarchical order can directly route the traffic to each other's interconnection so that they don't really have to deal with higher level ISPs while offering better performance as the connection offers lower latency and delays while streaming games, videos streaming, etc.

IXP stands for Internet Exchange Point (IXP). They earn money by offering different services for the connection between networks depending on the bandwidth capacity. They also charge port fees which are the monthly charges that a service provider has to pay for physical connections to exchange fabric. They also could provide cooling, space and power for ISP equipment with remote pairing capabilities, and maybe network monitoring tools to earn money through these services.

Question No. 3 Answer:

There are different kinds of delays when you are sending a packet from a source host to a destination host over a fixed route that is responsible for affecting the total end to end delay. The first type of delay is processing delay which occurs in each router along the fixed path which consists of examining packet header, determining the appropriate interface. This day is variable as it is dependent on several factors like current processing load and the complexity of the routing decisions.
Another delay after this is queuing delay which is the delay that occurs when a package has to wait in the output buffer for the time being until another package is being transferred. This delay is also variable as the time to wait could depend upon a lot of things like network traffic levels and congestion.
The other delay is transmission delay. Transmission delay is given by the packet size divided by the link's transmission rate. This delay is the time that it takes to load the packet's bits onto the transmission medium and remains constant for packets of the same size on the same link regardless of network conditions.
Propagation delay is another type of delay which is the delay that accounts for the time taken for the signal to physically travel through the transmission medium from sender to receiver. This can be calculated as the physical distance divided by the signal propagation speed in that medium.

In different delays, transmission and propagation delays are constant for a given packet size and path while the processing and queuing delays are variable.

Question No. 4 Answer:

4.a) From the figure, we can say that there are four switches (A, B, C, D) and 4 circuits per link. So each link can support 4 circuits and with four links which are total, the maximum becomes 16 simultaneous connections.

b) If all the connections are between A and C only then, the maximum number of connections is a bit more constrained. Each link can support 4 circuits and the A-C path uses 2 links. The bottleneck principle gets applied here as it states that the maximum number of simultaneous connections is limited by the most constrained link or the combination of links in the possible path. So the maximum number of simultaneous connections between them would most likely be four.

c) So, if we can fulfill this connection or not totally depends on the A-C connection and if we can use other links rather than the links between B-D. As we will have to compete for

the same resources it could cause bottlenecks in that situation which will not let us to satisfy that requirement. But if we are using different links to accommodate that 8 connections where the paths between A and C are completely different from the B and D then we can accommodate that.

Question No. 5 Answer: